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Takabayashi et al.

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(54) **MOTHERBOARD MOUNTING STRUCTURE, IMAGE FORMING APPARATUS AND METHOD FOR PERFORMING THE SAME**

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H05K 1/14	(2006.01)
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H05K 7/02	(2006.01)
H05K 3/00	(2006.01)
G03G 21/16	(2006.01)

(52) **U.S. Cl.**

CPC ***G03G 15/80*** (2013.01); ***G03G 21/1652*** (2013.01); ***H05K 3/00*** (2013.01); ***H05K 7/02*** (2013.01); *Y10T 29/49124* (2015.01)

(58) **Field of Classification Search**

USPC 361/788, 796–803, 752–753

See application file for complete search history.

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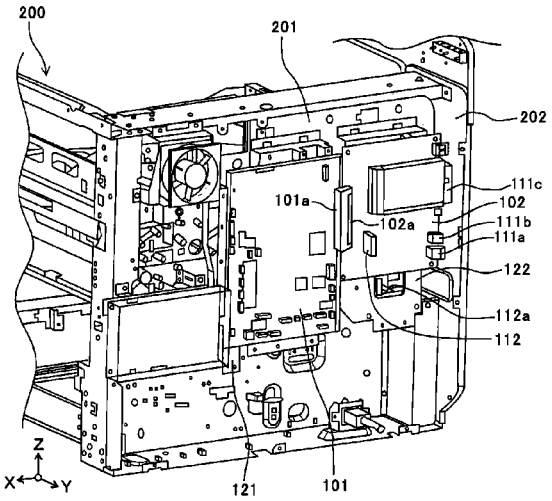
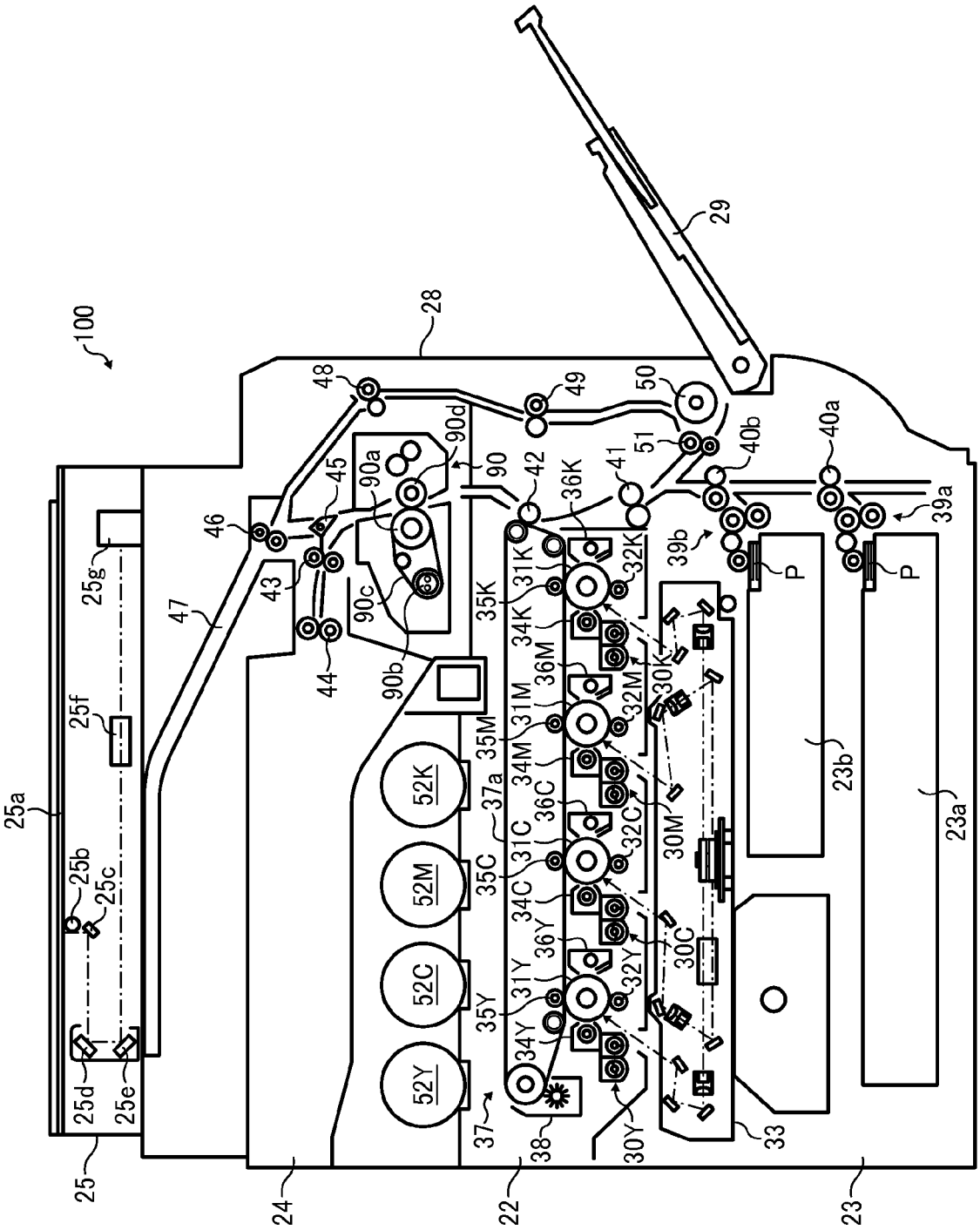
(57) **ABSTRACT**

A motherboard mounting structure includes a first board having a first connector and a second board having a second connector electrically connected directly to the first connector of the first board. The second board includes an external terminal connectable to an external device. The external terminal is inserted (or extracted) through an external terminal insertion opening formed on an orthogonal surface of a mainframe orthogonal to a surface of the second board. A mounting board is provided and to which the first and second boards are attached. The second board is attached to the mounting board with the external terminal protruding from the external terminal insertion opening. The first and second boards are slidably attached in a prescribed direction to separate from the orthogonal surface of the mainframe.

17 Claims, 7 Drawing Sheets

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90b
35K
31K
32K
39b
39a
P
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25g
25f
25a
25b
25c
25d
25e
25
24
22
23
52K
52M
52C
52Y
37a
35M
34M
36M
31M
32M
30K
35C
34C
36C
31C
32C
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32Y
30C
37
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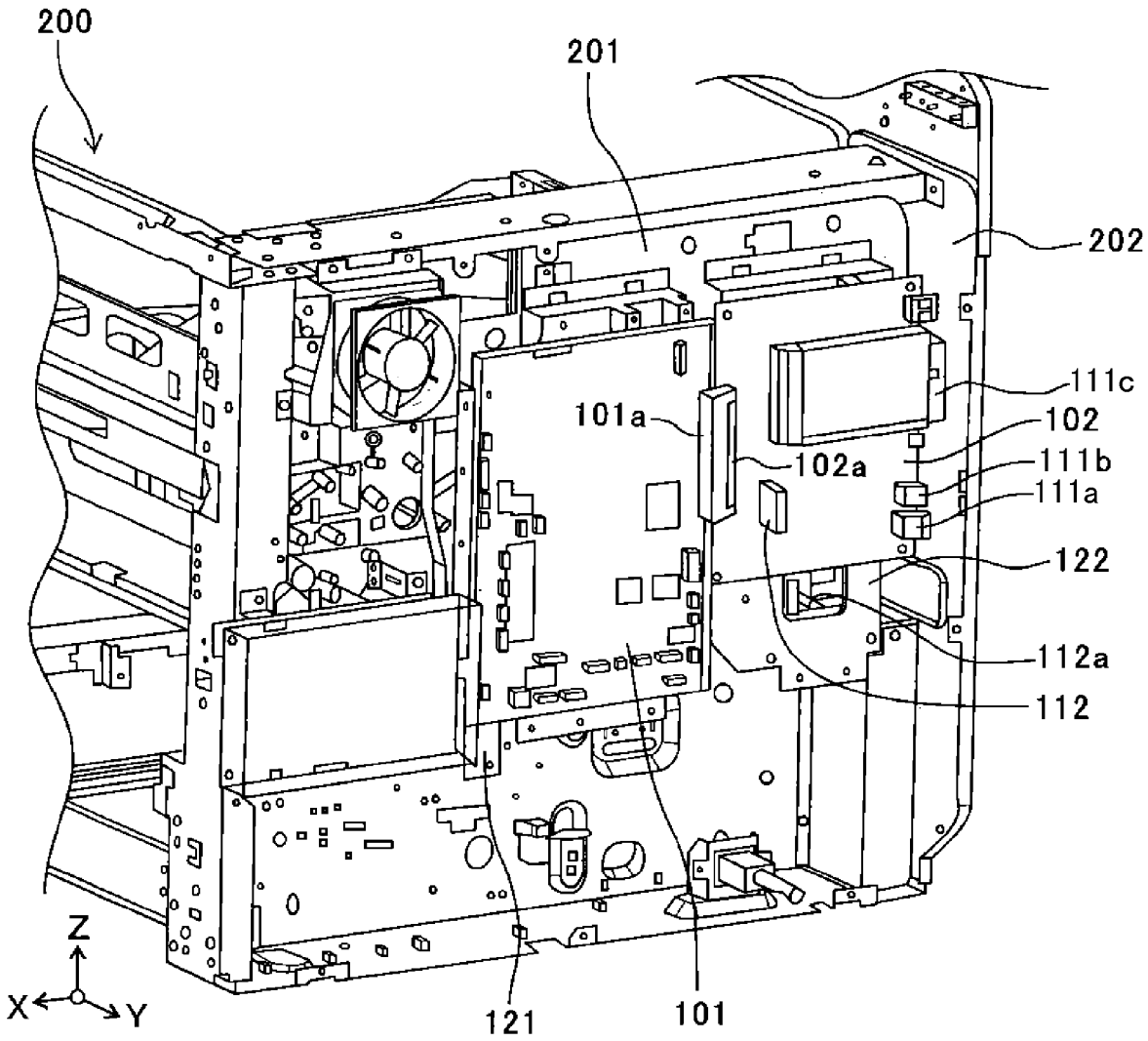
30Y
33
23b
23a

FIG. 1

FIG. 2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101

FIG. 3

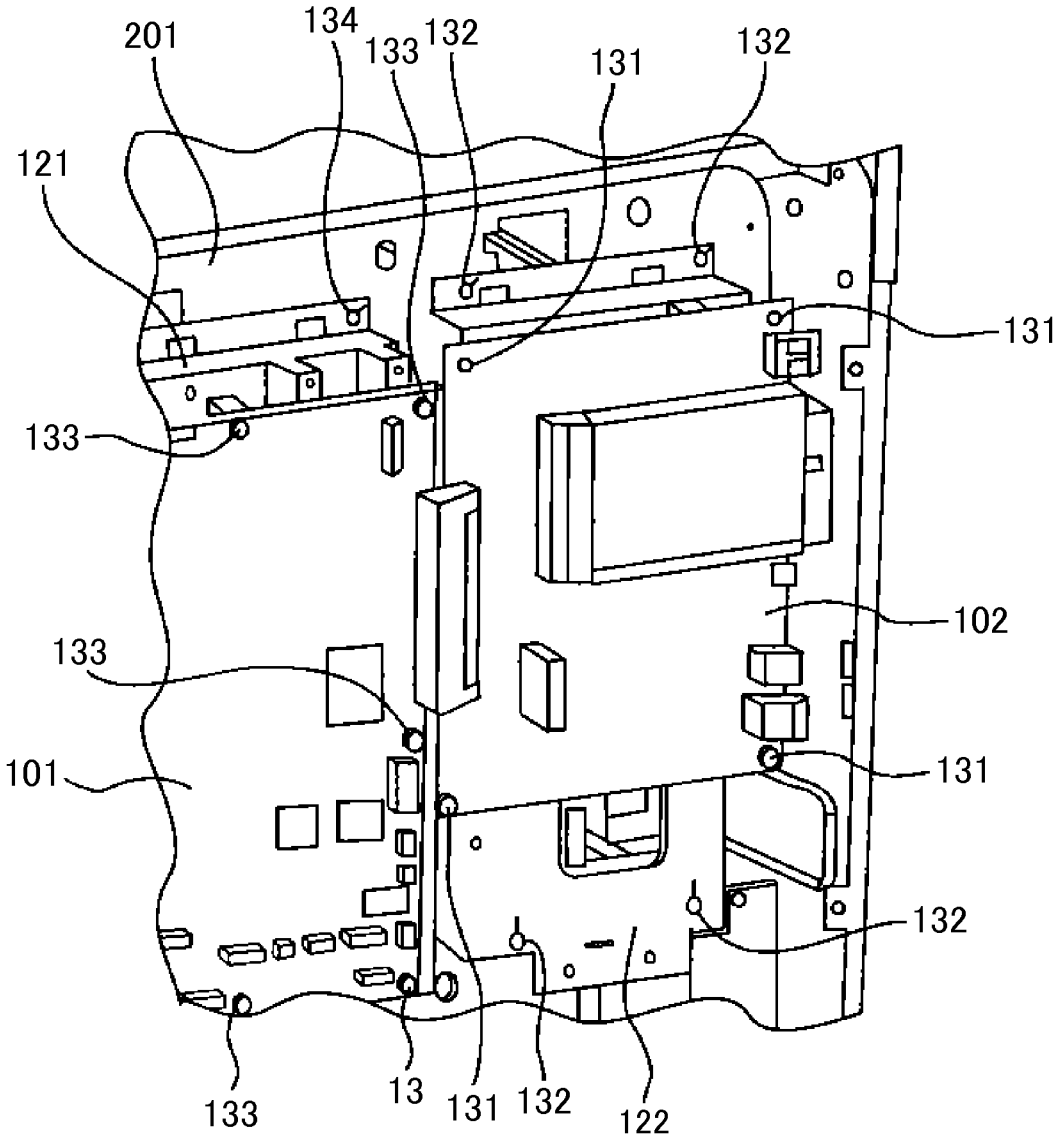
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FIG. 4

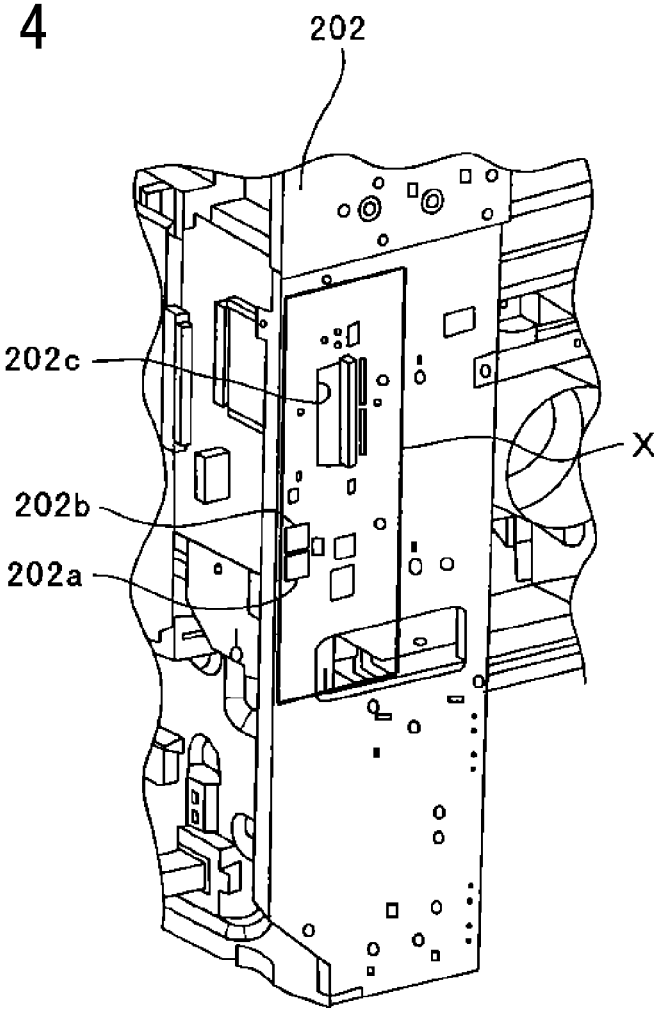
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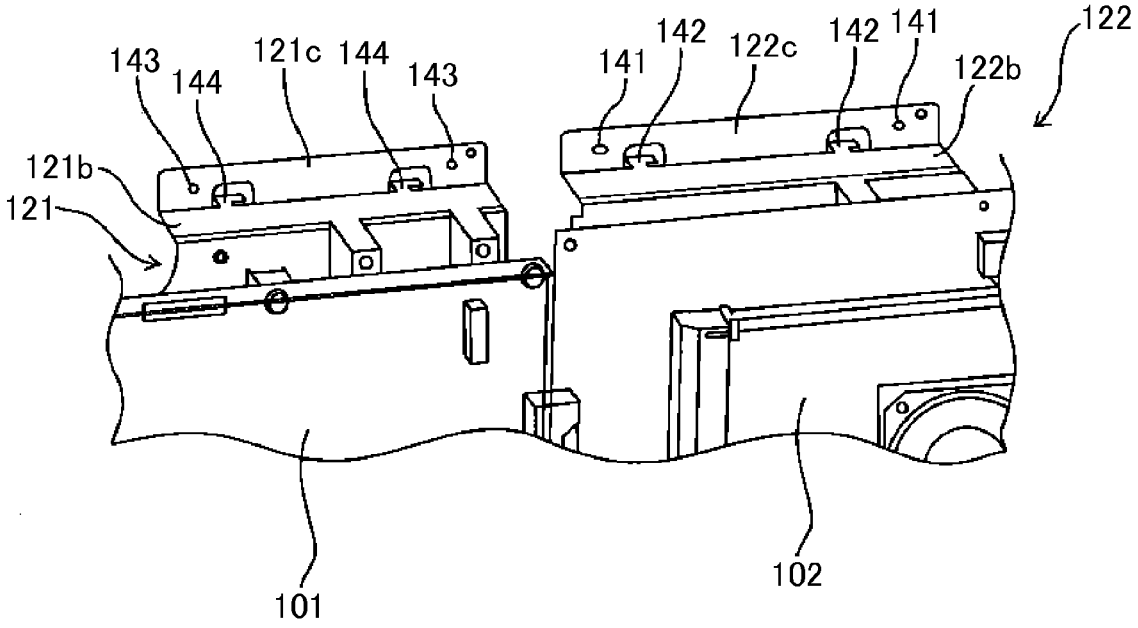
FIG. 5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102

FIG. 6

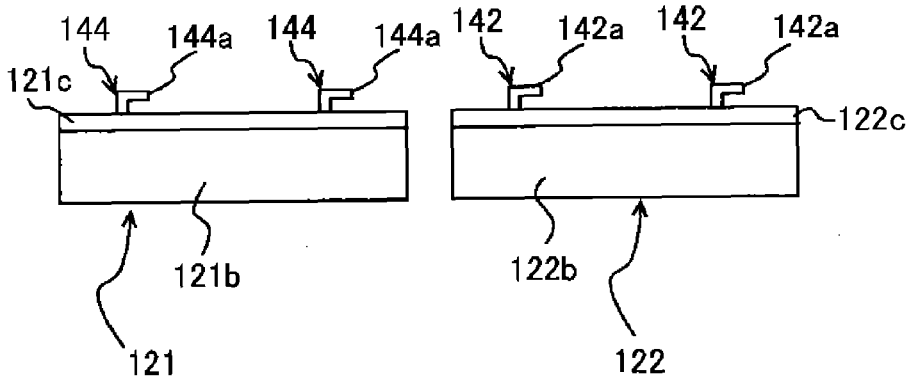


FIG. 7

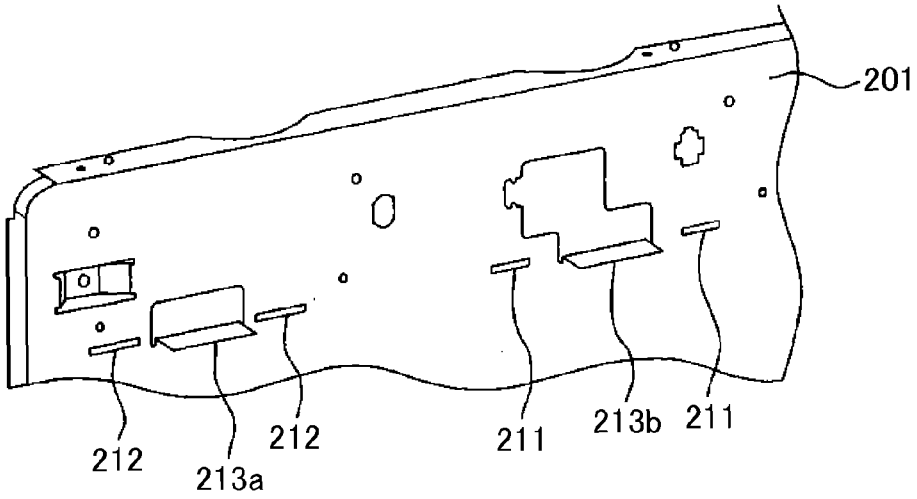


FIG. 8

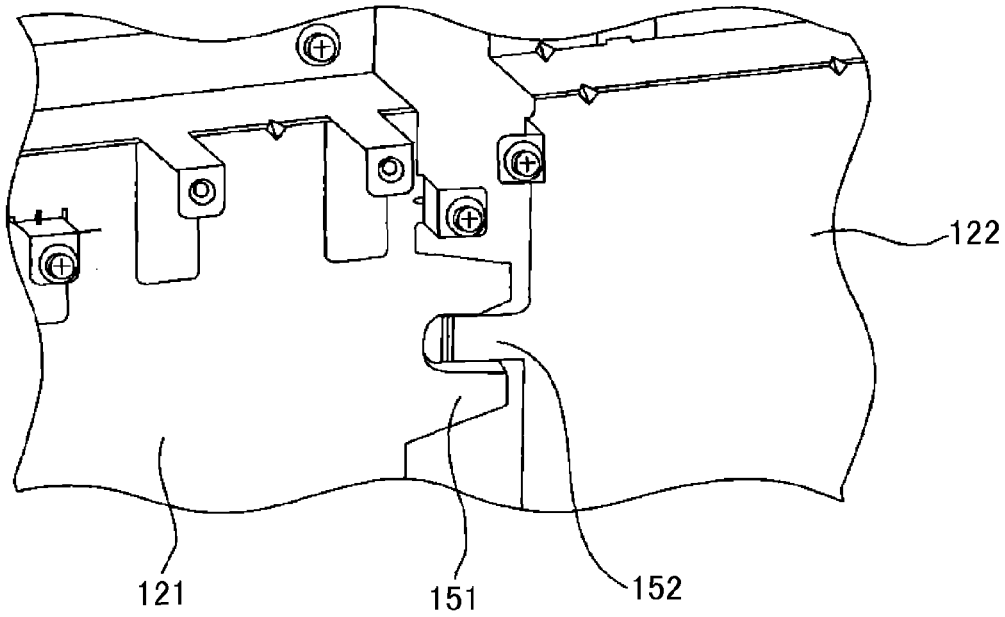


FIG. 9A

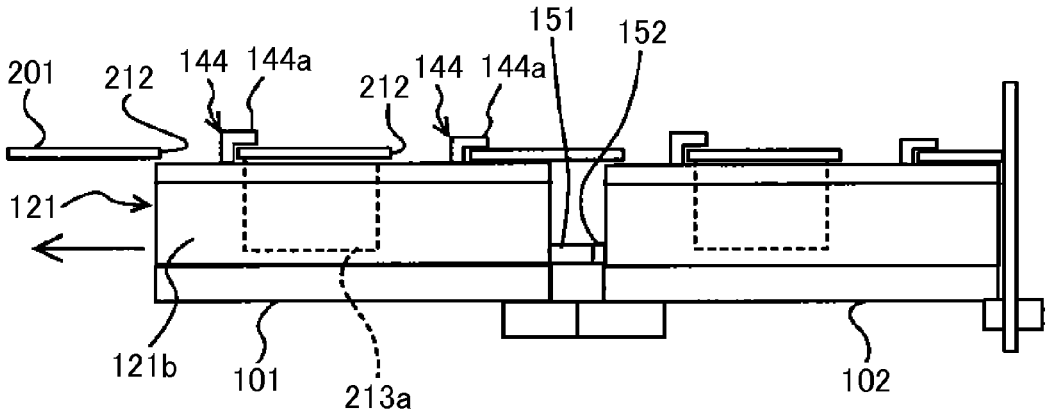


FIG. 9B

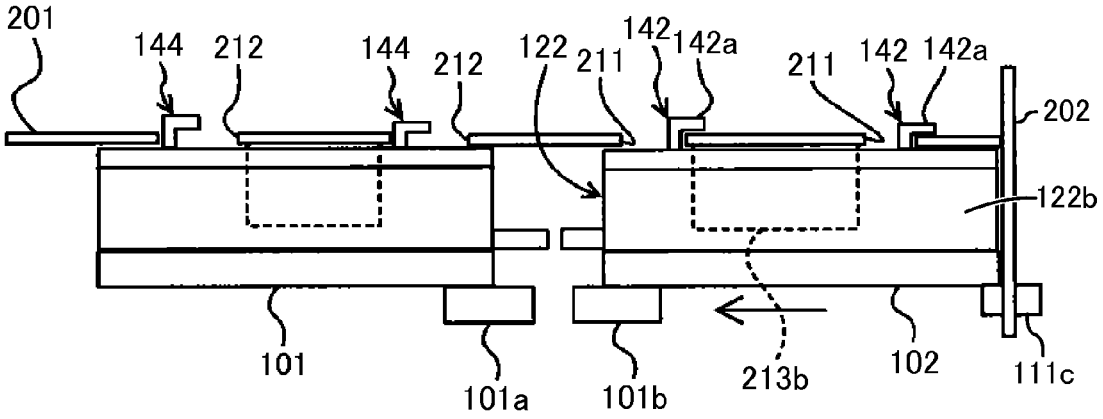


FIG. 9C

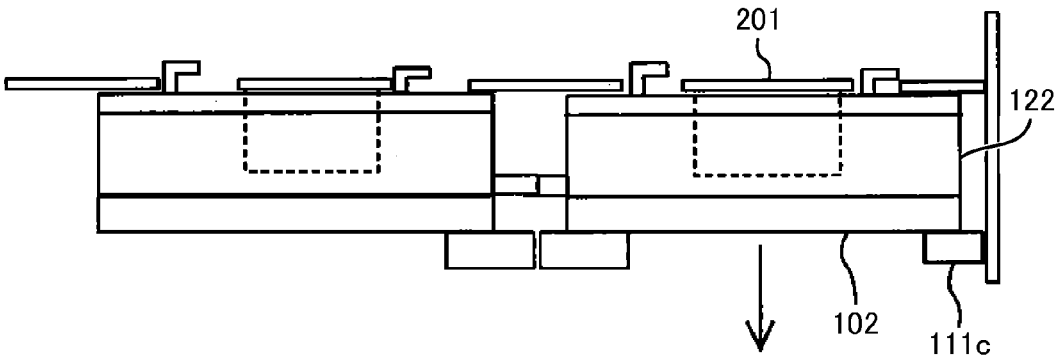
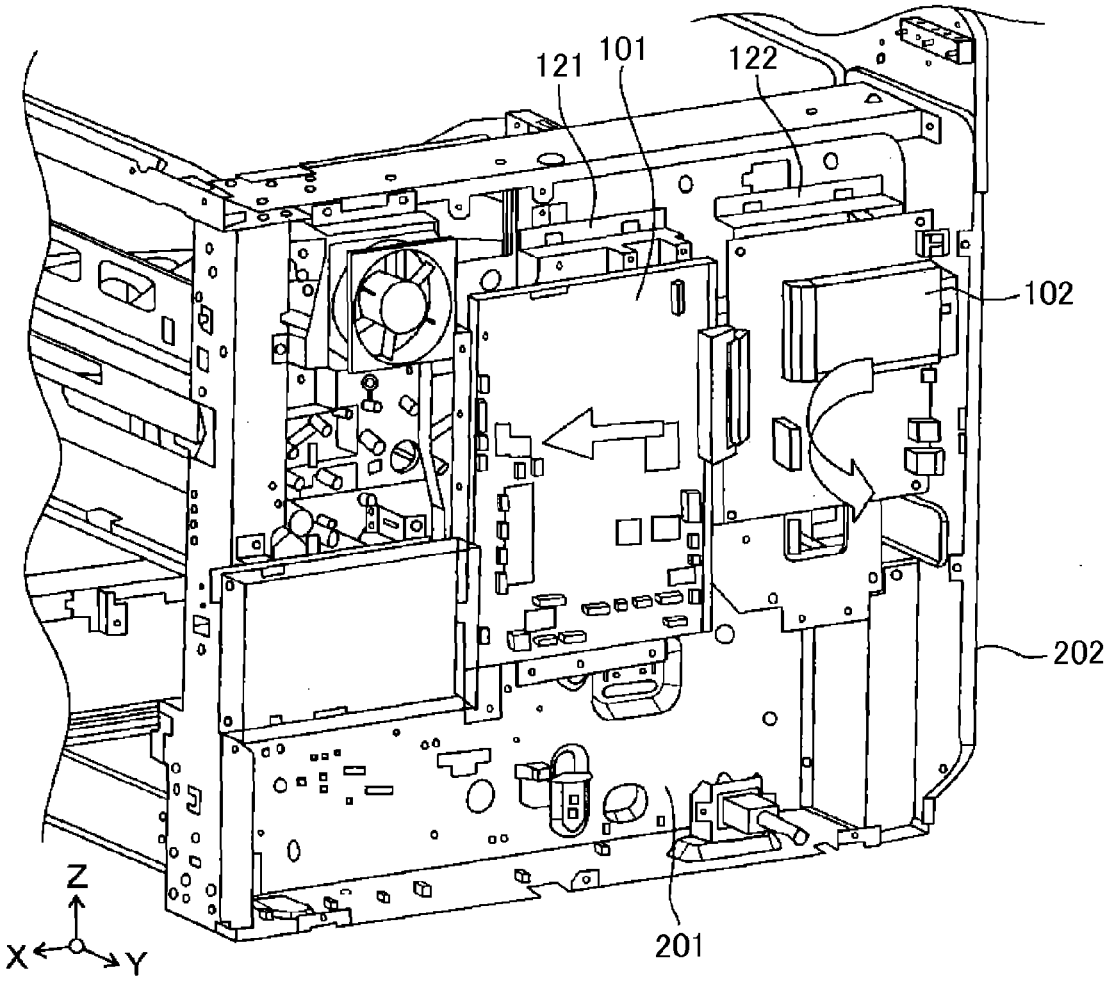


FIG. 10



MOTHERBOARD MOUNTING STRUCTURE, IMAGE FORMING APPARATUS AND METHOD FOR PERFORMING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

This patent application is based on and claims priority pursuant to 35 U.S.C. §119 to Japanese Patent Application No. 2012-052726, filed on Mar. 9, 2012 in the Japanese Patent Office, the entire disclosure of which is hereby incorporated by reference herein.

BACKGROUND

1. Field

The present invention relates to a motherboard mounting structure and an image forming apparatus with the motherboard mounting structure.

2. Related Art

An image forming apparatus, such as a copier, a printer, a facsimile machine, etc., has a motherboard that generally controls an image forming apparatus and a control board having one or more external terminals that connect to an external device, such as a personal computer, etc. The motherboard and the control board are electrically connected by directly plugging a connector of the control board in a connector of the motherboard bypassing a harness or the like. The control board is secured to a mainframe of the image forming apparatus serving as a mounting board with its external terminals protruding toward an exterior of the image forming apparatus.

Further, an expansion terminal is sometimes provided in the control board for connecting an expansion unit to enhance the functionality of the image forming apparatus. For example, an HDD that stores image data or the like may be connected to expand memory capacity of the apparatus.

When the expansion unit is to be connected, the control board needs to be removed from the image forming apparatus. Therefore, the connector of the control board needs to be extracted from the connector of the motherboard. According to one example as disclosed in Japanese Patent No. JP-4091747-B (JP-2002-246773-A), an opening is formed in the surface of a mainframe of an image forming apparatus perpendicular to a surface the control board (hereinafter referred to as an orthogonal surface of the mainframe of the image forming apparatus) to allow removal of the control board from the mainframe of the image forming apparatus. Therefore, the control board is attached to a bracket slidably disposed in the mainframe of the image forming apparatus, which bracket has a cover plate that blocks the opening in the orthogonal surface of the mainframe. In this bracket, an expansion unit mount is provided to accommodate the expansion unit.

When the expansion unit, such as an HDD, etc., is added, the bracket is slid and moved to extract the control board from the opening in the orthogonal surface. Then, the connector of the control board and the connector of the motherboard are separated from each other, and the control board is after that removed from the opening in the orthogonal surface together with the bracket to an exterior of the image forming apparatus.

Subsequently, the expansion unit is attached to the expansion unit mount of the bracket and is then connected to the expansion terminal provided on the control board using a harness. When the expansion unit is connected to the expansion terminal in this way, the bracket is inserted through the opening in the orthogonal surface together with the expansion unit and the control board.

When the bracket is inserted from the opening in the orthogonal surface into the mainframe of the image forming apparatus, the connector of the control board attached to the bracket is plugged into the connector of the motherboard. At the same time, the cover plate blocks the above-described opening in the orthogonal surface. With this, the installation of the control board into the mainframe of the image forming apparatus is completed, so that the expansion unit is added.

However, in such a conventional configuration, the opening in the orthogonal surface becomes relatively large in order to enable the control board to be extracted from the mainframe of the image forming apparatus, thereby compromising the structural integrity of the image forming apparatus mainframe. Further, since the cover plate is needed in the control board to block the opening in the orthogonal surface, the number of components, and accordingly the device cost increase as a result.

SUMMARY

Accordingly, the present invention provides a novel parts-mounted board structure that includes a first board at least having a first connector and a second board having a second connector electrically connected directly to the first connector of the first board. The second board includes an external terminal connectable to an external device. The external terminal is inserted through an external terminal insertion opening formed on an orthogonal surface of a mainframe orthogonal to a surface of the second board. A mounting board is provided to which the first and second boards are attached. The second board is attached to the mounting board with the external terminal protruding from the external terminal insertion opening. The first and second boards are slidably attached in a prescribed direction to separate from the orthogonal surface of the mainframe.

In another aspect of the present invention, a first bracket is provided to hold the first board. A second bracket is also provided to hold the second board. A first guiding hole is formed on one of the first bracket and the mounting board to extend perpendicular to the orthogonal surface of the mainframe of the image forming apparatus. A first guiding projection is formed on the other one of the first bracket and the mounting board to be inserted into the first guiding hole. A second guiding hole is formed on one of the second bracket and the mounting board to extend perpendicular to the orthogonal surface of the mainframe of the image forming apparatus. A second guiding projection is also formed on the other one of the second bracket and the mounting board to be inserted into the second guiding hole.

In yet another aspect of the present invention, the mounting board is a plate member extending perpendicular to a horizontal plane. A hook is disposed on a tip of the guiding projection extending perpendicular to the orthogonal surface of the mainframe of the image forming apparatus to hook onto the mounting board.

In yet another aspect of the present invention, the second board includes an expansion terminal connected to an expansion unit to enhance the functionality of an internal device. The second bracket includes an expansion unit mounting section, to which the expansion unit is attached.

In yet another aspect of the present invention, a connector guide is provided to guide the first connector of the first board

to the second connector of the second board when the first connector of the first board is connected to the second connector of the second board.

In yet another aspect of the present invention, the connector guide guides the first connector of the first board to the second connector of the second board before the first connector of the first board contacts the second connector of the second board.

In yet another aspect of the present invention, the second board is attached to the mounting board with a screw.

In yet another aspect of the present invention, an image forming apparatus includes an image formation device to form an image on a recording medium and the above-described parts-mounted board with multiple parts-mounted boards mounted thereon.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the present invention and many of the attendant advantages thereof will be more readily obtained as substantially the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. **1** is a schematic configuration of a copier as an image forming apparatus according to one embodiment of the present invention;

FIG. **2** illustrates a mainframe of the copier and a control board to control the copier according to one embodiment of the present invention;

FIG. **3** is an enlarged perspective view illustrating a portion near the control board according to one embodiment of the present invention;

FIG. **4** is an enlarged perspective view illustrating a side plate according to one embodiment of the present invention;

FIG. **5** is a perspective view illustrating respective essential portions of a main bracket and a sub-bracket according to one embodiment of the present invention;

FIG. **6** is a schematic plan view of the main bracket and the sub-bracket when viewed from the above;

FIG. **7** is a perspective view illustrating an essential portion of a rear side plate according to one embodiment of the present invention;

FIG. **8** is a perspective view illustrating respective portions almost opposed to connectors of the main bracket and the sub-bracket;

FIGS. **9**A, **9**B, and **9**C are schematic diagrams illustrating removal of the sub-bracket from the mainframe of the image forming apparatus according to one embodiment of the present invention; and

FIG. **10** is a perspective view illustrating the aspect when the sub-bracket is removed from the mainframe of the image forming apparatus.

DETAILED DESCRIPTION

Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views thereof and in particular to FIG. **1**, a copier employing an electrophotography system (hereinafter simply referred to as a copier machine **100**) is described as one exemplary embodiment of an image forming apparatus, to which the present invention is applied. As show there, the image forming apparatus of this embodiment is the copier machine **100** with a document scanning unit and an image formation unit. However, the copy machine **100** can be used as a printer, a scanner, and a facsimile machine by connecting with a LAN (Local Area Network) cable or a telephone line.

In the copy machine **100**, a printer unit **22** is placed at a center of the mainframe as an image formation unit, while a two-step feeder unit **23** is located right under the printer unit **22**. Further, a sheet ejection unit **24** of a so called built-in type is provided above the printer unit **22**. Beside, a scanner unit **25** is disposed above the sheet ejection unit **24** as a document reader.

The scanner part **25** located above the printer unit **22** includes a platen glass **25***a* as a document table on which a document is placed and a light source **25***b* that illuminates the document or the like. Further, first to third mirrors **25***c*, **25***d*, and **25***e*, etc., are provided to reflect light reflected from the document. An image sensor **25***g* to read an image of a document as a reader means, such as a CCD (Charge Coupled Device), etc., and an imaging lens **25***f* imaging the reflected light from the document placed at an imaging position are provided. Above the scanner unit **25**, there are provided a pressing cover that presses the document against the platen glass **25***a* and an automatic document feeder (ADF), not shown, that automatically feeds the document to the platen glass **25***a*.

The printer unit **22** is disposed at a center of the copy machine **100** and includes four image forming units **30** Y, **30**M, **30**C, and **30**K to form images of respective colors of cyan (C), magenta (M), yellow (Y), and black (K). Above the image forming units **30**Y, **30**M, **30**C, and **30**K, an intermediate transfer unit **37** having an intermediate transfer belt **37***a* as an endless belt type intermediate transfer unit is located. Below the image forming units **33**Y **30**M, **30**C, and **30**K, an optical writing device **33** is also disposed.

The image forming units **30**Y, **30**M, **30**C, and **30**K have substantially the same configuration with each other and include image carriers as the photoconductive drums **31**Y, **31**M, **31**C, and **31**K, respectively. Further, around photoconductors, charging devices **32**Y, **32**C, **32**M, and **32**K, developing devices **34**Y, **34**C, **34**M, and **34**K, primary transfer rollers **35**Y, **35**C, **35**M, and **35**K, and cleaners **36**Y, **36**C, **36**M, and **36**K are located, respectively.

The optical writing device **33** is arranged to be used by the four image forming units **30**Y, **30**M, **30**C, and **30**K having one deflector at a center, and distributes light flux from four light-beam into four routes therewith thereby providing deflection scanning, and writes latent images on the respective four photoconductive drums **31**Y, **31**C, **31**M, and **31**K. Further, the optical writing device **33** is configured from four light sources of a laser diode (LD) type prepared for each color, and a first optical system to collimate the laser beam emitted from the light sources, a polygon mirror (e.g., a rotating polygonal mirror), and a deflector consisting of a polygon motor (e.g., a polygon scanner). The optical writing device **33** is also configured from a second optical system mainly consisting of a scanning and imaging lens, such as an f-θ lens, etc., and a correction lens. Therefore, the laser beam emitted from the laser diode according to each color image information is subjected to the deflection scanning by the polygon scanner, and is irradiated to each of the color photoconductive drums **31**Y, **31**C, **31**M, and **31**K.

Further, between the printer unit **22** and the sheet exit unit **24**, multiple toner bottles are provided to replenish toner to the developing devices **34**Y, **52**Y, **52**C, **52**M, and **52**K **34**C, **34**M, and **34**K installed in the image forming units **30**Y, **30**M, **30**C, and **30**K, respectively. In toner bottles **52**Y, **52**C, **52**M, and **52**K, cyan (C), magenta (M), yellow (Y), and black (K) toner particles are filled in this order from the left in the drawing. From these toner bottles **52**Y, **52**C, **52**M, and **52**K, a given replenishment amount of toner of each color is replen-

ished through each conveyance path, not shown, to each of the color developer units **34**Y, **34**C, **34**M, and **34**K.

The intermediate transfer belt **37***a* in the intermediate transfer unit **37** is stretched by driving and driven rollers and a primary transfer roller as well and is thus rotated in a direction as shown by arrow in the drawing. There is provided a secondary transfer roller **42** on the right side of the intermediate transfer belt **37***a*. Whereas, on the left side of the intermediate transfer belt **37***a*, there is provided an intermediate transfer belt cleaner **38**.

In the sheet feeding device **23** located below the copy machine **100**, two-steps of first and second sheet feeding cassettes **23***a* and **23***b* are installed to accommodate transfer sheets P as recording media. From one of the sheet feeding cassettes **23***a* and **23***b*, a first feeder **39**A or a second sheet feeder **39***b* feeds the transfer sheet P. The transfer sheet P is further fed via either a first or a second conveyance roller **40***a* or **40***b* toward a registration roller **41**. Further, the transfer sheet P fed to the registration roller **41** is sent out toward a secondary transfer roller **42** at a prescribed time.

Above the secondary transfer roller **42**, a fixing unit **90** is disposed. In the fixing unit **90**, a fixing belt **90***c* supported by a fixing roller **90***a* and a heating roller **90***b* and a pressure rollers **90***d* pressing against the fixing belt **90***c* are provided. Above the fixing unit **90**, the transfer roller **43** and the sheet ejection roller **44** are provided to convey and eject the sheet P toward the sheet exit unit **24**. Further, yet above the transfer roller **43** and the sheet ejection roller **44**, there are provided a switching nail **45** for switching a conveyance path in a double-sided printing mode, a reverse transfer roller **46**, and a reversal conveyance path **47** to flip a direction of the sheet P in a switch back manner. A direction of the sheet P temporary stacked on the reversal conveyance path **47** is inverted by the reverse conveyance roller **46**, and the sheet P is further transferred through a duplex sheet feeding path by first and second double-side conveyance rollers **48** and **49**, and is then fed again toward the registration roller **41**.

Now, exemplary operation of the image forming apparatus is described herein below. When a copy is made, the pressing cover is opened and a document is placed on the platen glass **25***a* in the scanner unit **25**. Otherwise, the document is placed on an ADF (i.e., Automatic Document Feeder), not shown. In any way, when the document is placed on the ADF and a start switch is depressed on an operation unit **26**, the document set on the ADF is moved onto the platen glass **25***a*, and the scanner unit **25** is then driven. On the other hand, when the document is set on the platen glass **25***a*, the scanner unit **25** is driven, immediately. Subsequently, a first carriage that includes a light source **25***b* and a first mirror and a second carriage that holds second and third millers **25***d* and **25***e* are driven. Then, from the light source **25***b*, light is emitted and reflected by the surface of the document, and the light reflected therefrom is further reflected by the first mirror **25***c*, and is directed toward the second carriage. The light is then reflected by the second and third mirrors **25***d* and **25***e* and enters an image sensor **25***g* after passing through the imaging lens **25***f*, so that contents of the document are read by the imaging sensor **25***g*. When either a prescribed mode or an automatic mode is selected and set through the operation unit **26**, image forming operation is started in either a full-color or a black and white mode in accordance with a result of reading the document.

Specifically, in the printer unit **22**, the photoconductive drums **31**Y, **31**C, **31**M, and **31**K are initially charged uniformly by the charging units **32**Y, **32**C, **32**M, and **32**K, respectively. Then, the photoconductive drums **31**Y, **31**C, **31**M, and **31**K are scanned and exposed by laser light emitted from the optical writing device **33** having the four light sources, the four routes of the optical scanning systems, and a common deflector, so that electrostatic latent images are created on the respective photoconductive drums **31**Y, **31**C, **31**M, and **31**K. Each electrostatic latent image is developed by each of the color developing devices **34**Y, **34**C, **34**M, and **34**K and toner images of yellow, cyan, magenta and black are formed in the surfaces of the respective photoconductive drums **31**Y, **31**C, **31**M, and **31**K.

Subsequently, a primary transfer voltage is applied to each of the primary transfer rollers **35**Y, **35** C, **35**M, and **35**K, so that toner images on the photoconductive drums **31**Y, **31**C, **31**M, and **31**K are transferred one by one onto the intermediate transfer belt **37***a*. Image formation for respective colors at this time is executed at a different time from upstream to downstream, so that the toner images can be transferred and superimposed at the same position on the intermediate transfer belt **37***a*.

In synchronism with the primary transfer operations, the transfer sheet P as a recording medium is fed by one of the first and second sheet feeding units **39** and **39***b* from any one of the first and second transfer sheet feeding cassettes **23***a* and **23***b* as the sheet feeding device **23**. Otherwise, the transfer sheet P is fed by the sheet feeding roller **50** from the manual sheet insertion table **29**. A tip of the transfer sheet P is detected by a sensor, not shown, when it reaches the registration roller **41**. The transfer sheet P is conveyed by the registration roller **41** at a prescribed time timed based on a detection signal toward a secondary transfer nip formed between the intermediate transfer belt **37***a* and the secondary transfer roller **42**. The image formed on the intermediate transfer belt **37***a* is conveyed to the secondary transfer roller **42**, and is transferred onto the transfer sheet P at once during a secondary transfer operation. The transfer sheet P with the thus transferred image is then conveyed into the fixing unit **90** and the image is fixed by the heat and pressure. The transfer sheet P is further conveyed to the sheet exit unit **24** by a conveyance roller **43** and is ejected by a sheet exit roller **44**. Hence, a color image can be obtained finally on the transfer sheet P.

When the duplex mode is selected through the operation unit **26** and a two-sided copy is to be made, the switching nail **45** switches a conveyance path while the reverse conveyor roller **46** reverses an advancing direction and flips the transfer sheet P in a switch back manner after temporarily stacking the transfer sheet P with the fixed image on the reversal conveyance path **47**. Further, the transfer sheet P is conveyed by the first and second double-side conveyance rollers **48** and **49** toward the registration roller **41** through the duplex sheet conveyance path in synchronism with image formation. The registration roller **41** feeds the transfer sheet P to the secondary transfer unit again to transfer an image on a rear side of the transfer sheet P. The transfer sheet P with the image printed on the rear side thereof is subsequently conveyed into the fixing unit **90**, and the images are fixed by heat and pressure thereof. The transfer sheet P is then conveyed by the conveyance roller **43** toward the sheet exit unit **24** and is finally ejected by the sheet exit roller **44**. By this, a color image can be obtained on both sides of the transfer sheet P.

Residual toner particles on the photoconductive drum **31**Y, **31**M, **31**C, and **31**K are removed by the cleaners **36**Y, **36**C, **36**M, and **36**K, respectively. Afterward, the charging devices **32**Y, **32**C, **32**M, and **32**K, to each of which a DC and AC-components superimposed bias is applied, provide and remove charges simultaneously to and from the photoconductive drums **31**Y, **31**M, **31**C, and **31**K to prepare for the next image formation. Further, residual toner on the intermediate

transfer belt **37***a* is also removed by an intermediate transfer belt cleaner **38** to prepare for the next image formation step as well.

Although one exemplary interior of the image forming apparatus is described heretofore, the image forming apparatus according to the present invention is not limited thereto. That is, even though the tandem system employed image formation unit is described as one example in FIG. **2**, a color image formation unit with a single photoreceptor, multiple developing devices, and an intermediate transfer member (i.e., a so-called one-drum and intermediate transfer system) is also employable instead. Further, an image formation unit that only forms a monochromatic image is also employable. Further, although the configuration with the scanner unit **25** is described as one example as shown in FIG. **1**, a printer can be established if the scanner unit **25** is detached.

FIG. **2** is a perspective view illustrating a mainframe **200** of the copier and a control board that controls the copier. As shown in FIG. **2**, to a rear side plate **201** made of metal serving as a mount constituting the mainframe **200**, a motherboard **101** that generally controls an image forming apparatus is attached as a first board. A control board **102** with multiple external terminals **111***a*, **111***b*, and **111***c* that connects with an external device of the copier is also attached as a second board.

The motherboard **101** is held by a main bracket **121** made of metal attached to the rear side plate **201** as a first bracket. The control board **102** is held by a sub-bracket **122** that is made of metal and attached to the rear side plate **201** as a second bracket. Specifically, the sub-bracket **122** is attached to the rear side plate **201** with each of the external terminals **111***a*, **111***b*, and **111***c* mounted on the control board **102** protruding from the side plate **202** that serves as an orthogonal plane orthogonal to that of the control substrate **102** mounted on the mainframe **200**.

On the control board **102**, an expansion terminal **112** to connect with an expansion unit, such as HDD etc., that enhances the functionality of an internal device, is mounted. Specifically, the HDD expands image data storage capacity of a prescribed internal device. The expansion unit of the HDD or the like is attachable to an opposite surface (hereinafter referred to as a rear side) of the sub-bracket **102** to a surface onto which the control board **102** is attached. A wiring hole **112***a* is formed on the sub-bracket **122**. Thus, a harness is routed through this wiring hole **112***a* so that the expansion terminal is connected to the expansion unit attached to the rear side of the sub bracket **122**. By holding the expansion unit with sub-bracket **122** holding the control board **102** in this way, a component cost can be more reduced when compared with a mechanism in which brackets to hold the expansion unit and the control board **102** are separately employed.

Further, at one end (i.e., a left side end in the drawing) of the control board **102**, which is opposite the other end (i.e., a right side end in the drawing) in which the external terminals **111***a*, **111***b*, and **111***c* are mounted, there is provided a control connector **102***a* that directly connects with a main connector **102***a* of the motherboard **101**.

FIG. **3** is an enlarged perspective view illustrating the control board **102** and the vicinity thereof. As shown in FIG. **3**, four corners of the control board **102** are attached by screws **131** to the sub-bracket **122**, respectively. The sub-bracket **122** is attached to the rear side plate **201** by multiple screws **132**, respectively. In this way, by screwing the metal sub-bracket **122** with the control board **102** fixed thereto to the metal rear side plate **201**, the metal sub-bracket **122** can precisely engage the rear side plate **201**. Thus, electrical connection between the sub-bracket **122** and the rear side plate **201**, and accordingly grounding of the control board **102** can be ensured.

Further, the motherboard **101** is also attached by multiple screws **133** to the main bracket **121** made of metal, while the metal main bracket **121** is attached to the rear side plate **201** with multiple screws **134**. By this, the main bracket **121** can also precisely engage the rear side plate **201** and electrical grounding of the motherboard **101** can be also ensured.

FIG. **4** is a perspective view showing the side plate **202** exposing the external terminals **111***a*, **111***b*, and **111***c* mounted on the control board **102**. As shown in FIG. **4**, on the side plate **202**, there are provided first to third openings **202***a*, **202***b*, and **202***c* to expose the first, second, and third external terminals **111***a*, **111***b*, and **111***c* mounted on the control substrate **102**, respectively. A solid line X in the drawing indicates an opening formed on the side plate **202** when the control board **202** is configured to be removed and practically removed from the side plate **202**.

FIG. **5** is a perspective view showing an essential portion of the main and sub brackets **121** and **122**. The sub-bracket **122** is formed from a metal plate including a first bent portion **122***b* receiving a bending process near its upper end to be bent toward the rear side plate **201**, and a second bent portion **122***c* receiving the bending process at its tip to be bent in parallel to the rear side plate **201**. At left and right side ends of the second bent portion **122***c* in the drawing, multiple screw insertion holes **141** are formed to receive insertion of the screws **132** as illustrated back in FIG. **4**. Further, at prescribed positions more adjacent to a center than these screw insertion holes **141**, a pair of guiding projections **142** protruding to the rear side plate **201** from the second bent portion **122***c* is provided at a prescribed interval.

The main bracket **121** has almost a similar configuration as the sub-bracket **122**. Specifically, the main-bracket **121** is also formed from a metal plate including a first bent portion **121***b* receiving a bending process near its upper end to be bent toward the rear side plate **201**, and a second bent portion **121***c* receiving the bending process at its tip to be bent in parallel to the rear side plate **201**. At left and right side ends of the second bent portion **121***c* in the drawing, multiple screw insertion holes **143** are formed to receive insertion of the screws **133** as illustrated back in FIG. **4**. Further, multiple projections **142** protruding toward the rear side plate **201** from the second bent portion **122***c* are also provided at a prescribed interval.

FIG. **6** is a plan view schematically illustrating the main and sub brackets **121** and **122**. As shown in the drawing, multiple hooks **142***a* and **144***a* extending toward and facing the side plate **202** are disposed at tips of the guiding projections **144** and **142** provided on the brackets **121** and **122**, respectively.

FIG. **7** is a perspective view showing an essential portion of the rear side plate **201**. As shown in FIG. **7**, two pairs of guiding holes **211** and **212** are formed on the rear side plate **201** extending toward the side plate **202** at its positions opposed to the guiding projections **142** and **144** of the sub and main brackets **122** and **121**, respectively. Accordingly, the guiding projections **142** and **144** of the brackets **121** and **122** are inserted into the corresponding guiding holes **211** and **212**, respectively. Further, between the two guiding holes **211** into which the guiding projections **142** of the sub-bracket **122** are inserted, respectively, a sub-guide supporting surface **213***b* folded toward the control board **102** is provided. As described later in detail, the first bending portion **122***b* of the sub-bracket **122** is mounted and supported by the sub-guide support surface **213***b* until the sub-bracket **122** has been attached to the rear side plate **201** with a screw.

Similarly, between the two guiding holes **212** into which the guiding projections **144** of the main bracket **121** are inserted, respectively, a main-guide supporting surface **213***a* folded toward the motherboard **101** is provided. Accordingly, the first bending portion **121***b* of the main bracket **121** is mounted and supported by the main-guide support surface **213***a* until the motherboard **101** (i.e., the main bracket **121**) has been attached to the rear side plate **201** with the screw.

FIG. **8** is a perspective view illustrating portions of the main and sub brackets **121** and **122** opposed to the respective connectors **101***a* and **102***a*. As shown in FIG. **8**, a first concave connector guide **151** is provided at a prescribed position of the main bracket **121** opposed to the connector **101***a* of the motherboard **101**. Whereas, a second convex connector guide **152** is provided at a prescribed position of the sub-bracket **122** opposed to the connector **102***a* of the control board **102**. The tip of the first connector guide **151** protrudes from the connector **101***a* of the motherboard **101** toward the control board **102**. Further, a tip of the second connector guide **152** protrudes than that of the connector **102***a* of the control board **102** toward the motherboard **101**.

With such a configuration, when the main connector **101***a* is inserted into the control connector **102***a*, the tip of the second connector guide **152** enters a recess of the first connector guide **151** before the main connector **101***a* engages the control connector **102***a*. Thus, the main connector **101***a* moves being guided by the first and second connector guides **151** and **152** in a prescribed direction to precisely connect the main connector **101***a* with the control connector **102***a*.

When additionally attaching a expansion unit, such as a HDD, etc., to the rear side of the sub-bracket **122**, the sub-bracket **122** holding the control board **102** needs to be removed from the rear side plate **201** as illustrated in FIGS. **9**A to **10**.

Specifically, when adding the expansion unit of the HDD or the like, an exterior cover (not shown) of the copier is removed, and the control board **102** and the motherboard **101** attached to the rear side plate **201** are then exposed outside. Then, the screws **134** (see FIG. **3**) are removed, and the main bracket **121** and the rear side plate **201** are unscrewed to each other.

At this moment, as shown in FIG. **9**A, the hook portions **144***a* of the guiding projection **144** of the main bracket **121** are caught by (or hang on) an opposite side of the rear side plate **201** to a side holding the parts-mounted board, and the first bent portion **122***b* of the main bracket **121** is supported by the main guide supporting surface **213***a*. Hence, even when the screws **134** are removed, the main bracket **121** is inhibited to fall down.

When the main bracket **121** and the rear side plate **201** are unscrewed, the main bracket **121** (i.e., the motherboard **101**) is slid in a direction (shown by arrow in FIG. **9**A) to separate from the control board **102**. Hence, the main connector **101***a* and the control connector **102***a* are disconnected from each other as shown in FIG. **10**. At this moment, the convex second connector guide **152** of the sub-bracket **122** is guided by the concave first connector guide **151** of the main bracket, and the guiding projection **144** of the main bracket **121** is guided by the guiding hole **212**. Accordingly, the main bracket **121** (i.e., the motherboard **101**) can be moved in a direction to detach or attach the main connector **101***a*. Hence, the main connector **101***a* can be easily extracted from the control connector **102***a*.

Further, as shown in FIG. **9**B, the guiding projection **144** of the motherboard **101** bumps against a left side end of the guiding hole **212** (i.e., an end opposite the control board **102**) to prohibit the main bracket **121** (i.e., the motherboard **101**) to move in the connector attaching and detaching direction. Hence, the main bracket **121** (i.e., the motherboard **101**) is inhibited to excessively move and thereby colliding and damaging internal parts.

Further, when the guiding projection **144** of the motherboard **101** bumps against the left side end of the guiding hole **212** (an end opposite the control board **102**), and connection between the connector **101***a* of the motherboard **101** and the connector **102***a* of the control board **102** is cancelled as shown in FIG. **9**B, the screws **132** (see FIG. **3**) are removed so that the sub-bracket **122** and the rear side plate **201** are unscrewed to each other. At this moment, since the hooks **142***a* of the guiding projection **142** of the sub-bracket **122** are caught by (or hang on) an opposite side of the rear side plate **201** to a side holding the parts-mounted board, and the first bending portion **122***b* of the sub-bracket **122** is supported on the sub-guide supporting surface **213***b*, the sub-bracket **122** is prevented from falling down even when the screws **134** are removed.

When the sub-bracket and the rear side plate **201** are unscrewed to each other, the sub-bracket **122** (i.e., the control board **102**) is slid closer to the motherboard **101** as shown by arrow in FIG. **9**B. At this moment, since the guiding projection **142** of the sub-bracket **122** is guided by the guiding holes **211**, the sub-bracket **122** (i.e., the control board **102**) can be moved perpendicular to the side plate **202**. Hence, the external terminals **111***a*, **111***b*, and **111***c* protruding from the side plate **202** can be smoothly moved and drawn into an interior from the side plate **202**. Further, at this moment, the guiding projection **142** of the control board **102** bumps against the left end of the guiding hole **211** in the drawing (i.e., an end on the side of the motherboard) to prohibit the sub-bracket **122** (i.e., the control board **102**) from moving. Hence, the sub-bracket **122** (i.e., the control board **102**) is inhibited to excessively move and thereby colliding and damaging the motherboard **101** or the like.

Specifically, as shown in FIG. **9**C, the external terminals **111***a*, **111***b*, **111***c* are drawn into the interior from the side plate **202** via the external terminal openings **202***a*, **202***b*, and **202***c* on the side plate **202**, respectively. Hence, by moving the sub-bracket **122** (i.e., the control board **102**) away from the rear side plate **201** in this way, the sub-bracket **122** holding the control board **102** can be removed while prohibiting the external terminals **111***a*, **111***b*, and **111***c* from bumping against the external terminal openings **202***a*, **202***b*, and **202***c*, respectively.

Subsequently, the expansion unit of the HDD or the like is attached to the rear side of the sub-bracket **122** (i.e., the opposite side to a side holding the control board **102**) currently removed from the image forming apparatus with the control board **102**, and the harness is routed through the wiring hole of the sub-bracket **122** to connect the expansion unit with the expansion terminal **112** mounted on the control board **102**. The sub-bracket **122** holding the control board **102** to which the expansion unit is thus attached is installed into the mainframe of the image forming apparatus in a procedure reverse to the above-described detaching manner. Specifically, the guiding protrusions **142** of the sub-bracket **122** are inserted into the guiding holes **211** to move the sub-bracket **122** toward the side plate **202**. When the external terminals **111***a*, **111***b*, and **111***c* of the control board **102** protrude from the side plate **202** and the guiding projections **142** bumps against the right side ends of the guiding holes **211** (i.e., ends on the side of the side plate **202**) in the drawing, the sub-bracket **122** is attached to the rear side plate **201** with a screw. At this moment, the hook portion **142***a* is caught by (or hang on) the opposite side of the rear side plate **201** to the side holding the parts-mounted board, and the sub-bracket **122** is

supported on the sub-guide supporting surface **213***b*. Therefore, the sub-bracket **122** can easily be attached with the screws without falling down during its securing operation therewith.

Hence, when the sub-bracket **122** is attached to the rear side plate **201** with the screw, the main bracket **121** is moved toward the control board **102**. When the main bracket **121** is moved toward the control board **102**, the tip of the convex second connector guide **152** fits into the recess of the first connector guide **151**. Thus, the main connector **101***a* is guided to the first and second connector guides **151** and **152**, and is finally connected to the control connector **102***a*. Subsequently, the main bracket **121** is also attached to the rear side plate **201** with the screw. Again, at this moment, since the hook portions **144***a* are caught by (or hang on) the opposite side of the rear side plate **201** to the side holding the parts-mounted board while the main bracket **121** is supported on the main guide supporting surface **213***a*, the main bracket **121** can easily be attached without falling down during its securing operation with the screws.

Thus, in this embodiment, since the sub-bracket **122** holding the control board **102** can be taken out perpendicular to the surface of the parts-mounted board, at least openings need to be formed on the side plate **202** to expose the external terminals **111***a*, **111***b*, and **111***c* of the control board **102**. As a result, rigidity of the mainframe **200** can be maintained suppressing vibration thereof generally caused by vibration of an actuator which drives the photoconductive drum **31** or the like. Furthermore, since the member covering the opening is no longer needed on the sub-bracket **122** unlike the conventional apparatus, increase in the number of components can be suppressed reducing a device cost.

Further, a length of each of the guiding holes **211***a* and **211***b*, in which each of the guiding projections **142** of the sub-bracket **122** is inserted and moved, is preferably set to the minimum level capable of drawing the external terminals **111***a*, **111***b*, and **111***c* inside the side plate **202** from the external terminal openings **202***a*, **202***b* and **202***c* on the side plate **202**, respectively. With this, immediately when the external terminals **111***a*, **111***b*, and **111***c* enter the interior of the image forming apparatus from the external terminal openings **202***a* and **202***b* on the side plate **202**, the guiding projections **142** bump against the ends of the guiding holes **211** on the side of the motherboard **101**, respectively. Hence, necessity of movement of the sub-bracket **122** toward the motherboard can be minimized. Further, each of the guiding holes **212***a*, in which each of the guiding projections **144** of the main bracket **121** is inserted and moved, desirably has a minimum necessity length capable of avoiding the connectors from contacting each other when the sub-bracket is moved toward the main circuit parts-mounted board **101**. Specifically, the length of each of the guiding holes **212***a* is determined and set as the sum of a minimum length needed to disconnect the connectors from each other and a minimum length needed for the sub-bracket **122** to detach the external terminals **111***a*, **111***b*, and **111***c* from the respective openings **202***a*, **202***b* and **202***c* of the side plate **202**. Hence, the main bracket **121** can be inhibited to move unnecessarily.

In the above-described embodiment, after sliding the motherboard **101**, and disconnecting the main connector **101***a* and the control connector **102***a* from each other, the control board **102** is slid. However, the present invention is not limited thereto, and the connectors **101***a* and **102***a* can be disengaged from each other after both the motherboard **101** and the control board **102** are integrally slid drawing the external terminals into the image forming apparatus.

According to one embodiment, a parts-mounted board structure includes a first board having a first connector and a second board having a second connector and an external terminal connectable to an external device. The second board is electrically connected to the first board by directly inserting the second connector into the first connector. A mounting board, to which the first and second boards are attached, is provided. The second board is attached to the mounting board with the external terminal protruding from an external terminal insertion opening formed on an orthogonal surface of the mainframe of the image forming apparatus orthogonal to a surface of the second board. The external terminal is inserted into (or extracted from) the external terminal insertion opening. The first and second boards are slidably attached in a prescribed direction to separate from the orthogonal surface of the mainframe of the image forming apparatus.

Specifically, a first board at least includes a first connector. A second board has a second connector electrically connected directly to the first connector of the first board. The second board includes an external terminal connectable to an external device. The external terminal is inserted through an external terminal insertion opening formed on an orthogonal surface of a mainframe orthogonal to a surface of the second board. A mounting board is provided and to which the first and second boards are attached. The second board is attached to the mounting board with the external terminal protruding from the external terminal insertion opening. The first and second boards are slidably attached in a prescribed direction to separate from the orthogonal surface of the mainframe.

With such a configuration, a second board can be removed from the mainframe of the image forming apparatus without an opening in a surface to extract the second board. This can avoid weakening of the mainframe **200**. Further, a member to block the opening in the side plate **202** is no longer needed, thereby capable of promoting cost reduction of the device.

According to another embodiment, a first bracket is provided to hold the first board, and a second bracket is provided to hold the second board. A first guiding hole is formed on one of the first bracket and the mounting board to extend perpendicular to the orthogonal surface of the mainframe of the image forming apparatus. A first guiding projection is formed on the other one of the first bracket and the mounting board to be inserted into the first guiding hole. A second guiding hole is formed on one of the second bracket and the mounting board to extend perpendicular to the orthogonal surface of the mainframe of the image forming apparatus. A second guiding projection is also formed on the other one of the second bracket and the mounting board to be inserted into the second guiding hole. With such a configuration, the first and second boards can be slid apart from an orthogonal surface section of the above-described apparatus mainframe **200**.

According to yet another embodiment, the mounting board is a plate like member extending perpendicular to a horizontal plane. A hook is disposed on a tip of the guiding projection extending perpendicular to the orthogonal surface of the mainframe of the image forming apparatus to hook onto the mounting board. With such a configuration, the guiding projections **142** and **144** can be prohibited from deviating out of the guiding holes **211** and **212**, and the first and second brackets can be prohibited from falling from the above-described mounting board.

According to yet another embodiment, the second board includes an expansion terminal connected to an expansion unit to enhance the functionality of an internal device. The second bracket includes an expansion unit mounting section, to which the expansion unit is attached. With such a configuration, a component cost can be reduced more effectively than

a configuration in which a bracket to hold the expansion unit and a bracket to hold the second board are separately arranged.

According to yet another embodiment, a connector guide is provided to guide the first connector of the first board to the second connector of the second board when the first connector of the first board is connected to the second connector of the second board. With such a configuration, the connector **101***a* of the first board can be readily inserted into the connector **102***a* of the second board.

According to yet another embodiment, the connector guide guides the first connector of the first board to the second connector of the second board before the first connector of the first board contacts the second connector of the second board. With such a configuration, the connector **101***a* of the first board can be accurately guided easily to the connector **102***a* of the second board.

According to yet another embodiment, the second board is attached to the mounting board with the screw. With such a configuration, contact with the mounting board can be reliable and electrical grounding of the second board can be ensured.

According to yet another embodiment, an image forming apparatus includes an image forming apparatus to form an image on a recording medium, and the above-described parts-mounted board with multiple substrates mounted thereon. With such a configuration, weakening of the mainframe **200** can be suppressed reducing vibration thereof. As a result, an image is not distorted due to vibration of the photoreceptor or the like.

Numerous additional modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the present invention may be practiced otherwise than as specifically described herein.

What is claimed is:

1. A motherboard mounting structure comprising:
- a first board at least having a first connector;
- a second board having a second connector electrically connected directly to the first connector of the first board, the second board including an external terminal connectable to an external device, the external terminal being inserted through an external terminal insertion opening formed on an orthogonal surface of a mainframe orthogonal to a surface of the second board;
- a mount to which the first and second boards are attached;
- a first bracket to hold the first board;
- a second bracket to hold the second board;
- a first guiding hole formed on one of the first bracket and the mount, the guiding hole extending perpendicular to the orthogonal surface of the mainframe;
- a first guiding projection formed on the other one of the first bracket and the mount to be inserted into the first guiding hole;
- a second guiding hole formed on one of the second bracket and the mount, the guiding hole extending perpendicular to the orthogonal surface of the mainframe; and
- a second guiding projection formed on the other one of the second bracket and the mount to be inserted into the second guiding hole, wherein
  - the second board is attached to the mount with the external terminal protruding from the external terminal insertion opening, and
  - the first and second boards are slidably attached in a prescribed direction to separate from the orthogonal surface of the mainframe.

2. The motherboard mounting structure as claimed in claim **1**, further comprising:
- a connector guide to guide the first connector of the first board to the second connector of the second board when the first connector of the first board is connected to the second connector of the second board.

3. The motherboard mounting structure as claimed in claim **1**, wherein the second board is attached to the mount with a screw.

4. The motherboard mounting structure as claimed in claim **1**, wherein the mount is a plate member extending perpendicular to a horizontal plane, and the motherboard mounting structure further comprises:
- a hook disposed on a tip of the guiding projection extending perpendicular to the orthogonal surface of the mainframe to hook onto the mount.

5. The motherboard mounting structure as claimed in claim **4**, wherein the second board includes an expansion terminal connected to an expansion unit to enhance the functionality of an internal device provided inside the mainframe, wherein the second bracket includes an expansion unit-mount, to which the expansion unit is attached.

6. The motherboard mounting structure as claimed in claim **4**, wherein the connector guide guides the first connector of the first board to the second connector of the second board before the first connector of the first board contacts the second connector of the second board.

7. An image forming apparatus comprising:
- an image formation device to form an image on a recording medium; and
- at least one motherboard mounting structure including,
  - a first board at least having a first connector,
  - a second board having a second connector electrically connected directly to the first connector of the first board, the second board including an external terminal connectable to an external device, the external terminal being inserted through an external terminal insertion opening formed on an orthogonal surface of a mainframe orthogonal to a surface of the second board,
  - a mount to which the first and second boards are attached,
  - a first bracket to hold the first board,
  - a second bracket to hold the second board,
  - a first guiding hole formed on one of the first bracket and the mount, the guiding hole extending perpendicular to the orthogonal surface of the mainframe,
  - a first guiding projection formed on the other one of the first bracket and the mount to be inserted into the first guiding hole,
  - a second guiding hole formed on one of the second bracket and the mount, the guiding hole extending perpendicular to the orthogonal surface of the mainframe, and
  - a second guiding projection formed on the other one of the second bracket and the mount to be inserted into the second guiding hole, wherein
    - the second board is attached to the mount with the external terminal protruding from the external terminal insertion opening, and
    - the first and second boards are slidably attached in a prescribed direction to separate from the orthogonal surface of the mainframe.

8. The image forming apparatus as claimed in claim **7**, further comprising:
- a connector guide to guide the first connector of the first board to the second connector of the second board when

the first connector of the first board is connected to the second connector of the second board.

9. The image forming apparatus as claimed in claim **7**, wherein the second board is attached to the mount with a screw.

10. The image forming apparatus as claimed in claim **7**, wherein the mount is a plate member extending perpendicular to a horizontal plane, further comprising a hook disposed on a tip of the guiding projection extending perpendicular to the orthogonal surface of the mainframe to hook onto the mount.

11. The image forming apparatus parts-mounted board structure as claimed in claim **10**, wherein the second board includes an expansion terminal connected to an expansion unit to enhance the functionality of an internal device provided inside the mainframe, wherein the second bracket includes an expansion unit mount, to which the expansion unit is attached.

12. The image forming apparatus as claimed in claim **10**, wherein the connector guide guides the first connector of the first board to the second connector of the second board before the first connector of the first board contacts the second connector of the second board.

13. A method for detaching a first board at least having a first connector and a second board having a second connector electrically connected directly to the first connector of the first board from a mount provided in a motherboard mounting structure to which the first and second boards are attached,

the second board including an external terminal connectable to an external device, the external terminal being inserted through an external terminal insertion opening formed on an orthogonal surface of a mainframe orthogonal to a surface of the second board, the second board being attached to the mount with the external terminal protruding from the external terminal insertion opening,

the motherboard mounting structure including a first bracket to hold the first board, a second bracket to hold the second board, a first guiding hole formed on one of the first bracket and the mount, the guiding hole extending perpendicular to the orthogonal surface of the mainframe, a first guiding projection formed on the other one of the first bracket and the mount to be inserted into the first guiding hole, a second guiding hole formed on one of the second bracket and the mount, the guiding hole extending perpendicular to the orthogonal surface of the mainframe, and a second guiding projection formed on the other one of the second bracket and the mount to be inserted into the second guiding hole, the method comprising:

opening a front cover at the front;

exposing the first and second boards;

sliding the first and second boards in a direction perpendicular to the orthogonal surface of the mainframe to separate those therefrom; and

detaching one of the first and second boards at the front.

14. The method as claimed in claim **13**, wherein the motherboard mounting structure further includes a connector guide to guide the first connector of the first board to the second connector of the second board when the first connector of the first board is connected to the second connector of the second board.

15. The method as claimed in claim **13**, wherein the second board is attached to the mount with a screw.

16. The method as claimed in claim **13**,

wherein the mount is a plate member extending perpendicular to a horizontal plane,

wherein the motherboard mounting structure further includes a hook disposed on a tip of the guiding projection extending perpendicular to the orthogonal surface of the mainframe to hook onto the mount.

17. The method as claimed in claim **13**,

wherein the second board includes an expansion terminal connected to an expansion unit to enhance the functionality of an internal device provided inside the mainframe,

wherein the second bracket includes an expansion unit-mount, to which the expansion unit is attached.

* * * * *